FPP Calculation and Participant Outcomes

Fact Sheet

The Frequency Performance Payment (FPP) reform is introducing a new assessment and valuation of frequency performance. Participants will be rewarded or penalised based on how helpful their plant's behaviour was in controlling system frequency. Participants can improve their performance – and financial outcomes – by following their expected power output or consumption more closely.

The FPP reform mandates a new process for incentivising or penalising electricity generators, large loads and batteries based on their impact on system frequency. The method by which AEMO measures a unit's frequency performance and how this is used to determine both FPPs and the allocation of Regulation FCAS costs are outlined in the Frequency Contribution Factors Procedure (FCFP). This fact sheet provides a high-level summary of key components of FCFP.

Performance calculation

Performance refers to the degree to which a unit contributes to the need to raise or lower the frequency of the power system. For each unit, AEMO calculates two performance values every 4 seconds – one for when there is a need to increase the system frequency and the other for when there is a need to lower the system frequency. The aggregates of these 4-second performances respectively form the unit's Raise and Lower Performance over the 5-minute trading interval.

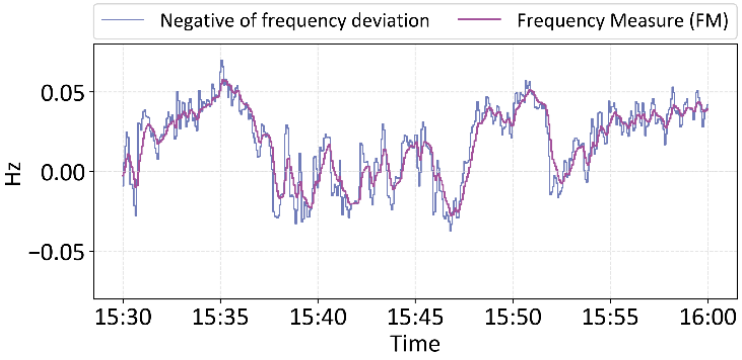
A unit's 4-second performance is calculated based on the Frequency Measure (FM) and the deviation of the unit from its Reference Trajectory.

Frequency Measure (FM)

Frequency Measure (FM) reflects the need to raise or lower power system frequency towards 50 Hz:

- A positive FM means the frequency should be increased.
- A negative FM means the frequency should be decreased.
- The larger the FM, the bigger the need.

For every region, an FM value is calculated at each 4-second interval, using the frequency deviations within that region. The figure below shows the frequency deviations and FM of a region over six trading intervals.

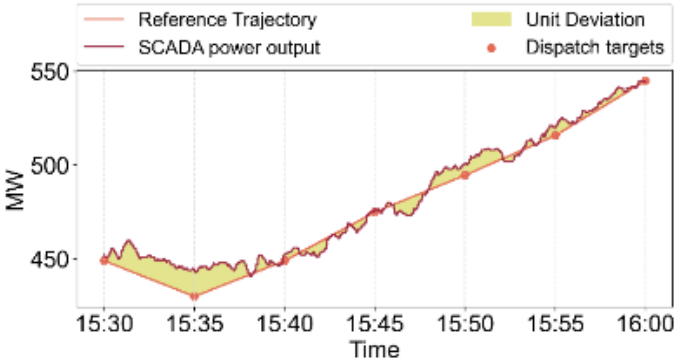


Reference Trajectory

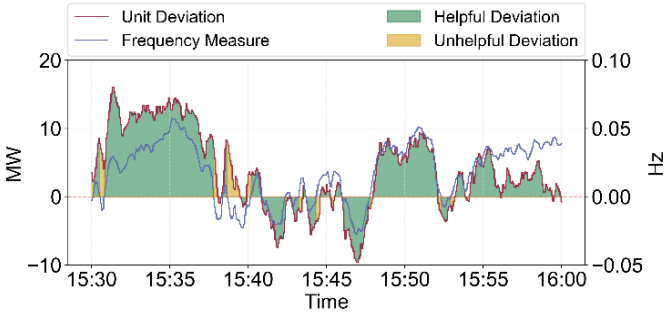
A unit's Reference Trajectory shows its expected active power output or consumption. The Reference Trajectory of Scheduled and Semi-Scheduled units is a straight line between the previous and current dispatch targets. The Reference Trajectory of Non-Scheduled units is a continuation of the unit generation at the start of the current trading interval.

Unit Deviation

AEMO calculates 4-second unit deviations (in MW) by comparing SCADA measurements against its Reference Trajectory. A positive deviation is one that increases the net amount of energy in the system (more generation or less load), and a negative deviation has the opposite effect. The figure below shows the Reference Trajectory, 4-second SCADA measurements, and deviations of a unit over six trading intervals.



A deviation that shares the same sign as the FM is deemed helpful and results in good performance and vice versa for a deviation that opposes the FM. The figure below illustrates this for a generating unit with PFR capability over six trading intervals.



Contribution Factors (CFs)

Following the calculation of Raise and Lower Performances of all units in a trading interval, AEMO normalises the Performances in each Regulation FCAS Requirement to determine Contribution Factors (CFs). A CF is between -1 and 1, where negative values show a unit's unhelpful frequency performance and positive values reflect a unit's helpful performance in frequency control. The positive and negative CFs will respectively be used to determine the incentives or penalties in the FPP system.

Default Contribution Factor (DCF)

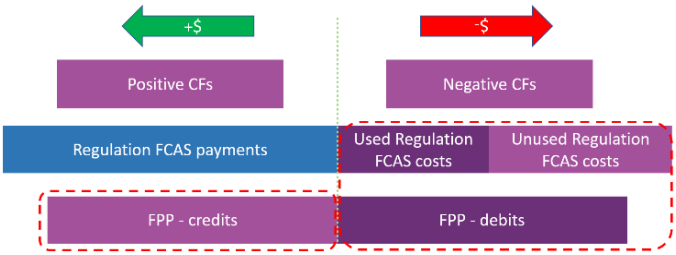
DCFs are determined based on the Historical Performance of units. AEMO calculates Raise and Lower Historical Performances for each unit, every week, based on the unit's Performance values over a 7-day historical period.

DCFs are used in two different ways:

1. For Unused Regulation FCAS cost allocation, DCFs are always used.
2. For Used Regulation FCAS cost allocation and FPP, DCFs are used only when the Performance of a unit cannot be calculated in a trading interval.

Trading amounts

The figure below illustrates how the FCFP trading amounts are calculated based on positive and negative CFs.



Frequency Performance Payments (FPPs)

The FPP system rewards units that have helpful frequency performance and penalises units with unhelpful frequency performance. Penalties and incentive payments are equal in each five-minute trading interval.

The FPP trading amount for units with appropriate real-time telemetry will be determined as:

$$TA = CF \times \frac{P_{regulation}}{12} \times RCR$$

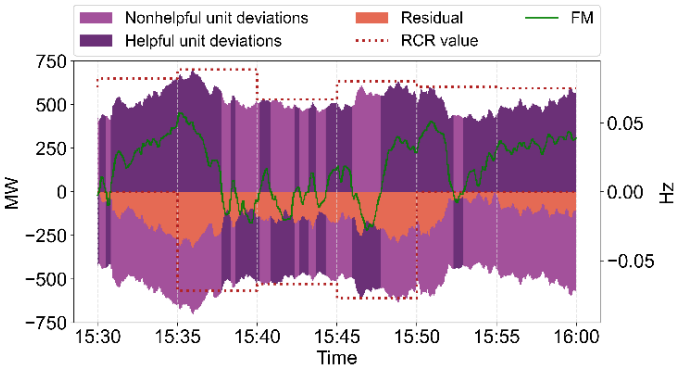
Where:

CF - Contribution Factor.

$P_{regulation}$ - marginal cost of the Regulation FCAS Requirement.

RCR - Requirement for Corrective Response. The RCR represents the peak volume of helpful response provided by all units in a given trading interval. An RCR is determined with respect to each Regulation FCAS Requirement and is used to scale the monetary value of FPP trading amounts.

The figure below depicts how the RCR corresponds to the maximum of the sum of all helpful deviations (including both units and Residual) during that interval.



Recovering Regulation FCAS costs

Under FPP reforms, the cost of Regulation FCAS will be recovered from units that have unhelpful frequency performance. The trading amounts will be allocated based on the amount of enabled Regulation FCAS that was used and unused within a trading interval, as follows:

$$TA_{used} = TSFCAS \times U \times NCF$$

$$TA_{unused} = TSFCAS \times (1 - U) \times DCF$$

Where:

$TSFCAS$ – the total cost of the Regulation FCAS requirement.

U – Usage. Usage reflects the proportion of enabled Regulation FCAS that was used within a trading interval.

NCF – Negative Contribution Factor.

DCF – Default Contribution Factor.

Improving FPP outcomes

Under the FPP reform, Market Participants will be rewarded for helpful performance and penalised for unhelpful performance. The amount debited is strongly linked to how closely a unit followed its Reference Trajectory. Facilities that deviate from their Reference Trajectories in an unhelpful manner can expect to receive FPP penalties.

Market Participants can improve the alignment of a unit's behaviour with its Reference Trajectory through the options listed below.

- Capital investments in technologies that are able to follow plant's set points more closely and/or provide primary frequency response would improve the FPP outcomes of variable renewable energy (VRE) facilities such as solar and wind farms. For example, the helpful performance of a co-located battery can compensate for the variation from solar/wind farms, especially when their generation falls short of forecasted output (i.e. “firming” the renewable output).
- Increasing their headroom to compensate for the inherent limitations on forecasting VRE output. If facilities have a larger buffer for when they cannot meet their targets, they can reduce the degree to which they deviate from their reference target at that time.
- Improving the accuracy of their self-forecasts. The expected output provided to AEMO by participants who self-forecast directly impacts their Reference Trajectory, other than when there are limitations in the network. The more accurate these forecasts are to their actual output the smaller their deviations.

Residual

The Residual refers to all facilities connected to the grid without appropriate real-time telemetry (4-second SCADA measurements) including small consumers and distributed resources. AEMO calculates the Residual deviation as the opposite of the deviation of all units in the relevant region that have an individual contribution factor. The Residual Performance is calculated on a regional basis which is then aggregated to determine the Residual CF. The FPP and Regulation FCAS recovery trading amounts of participants who are part of the Residual are determined based on their total adjusted gross energy amounts. In some instances, facilities may be able to arrange for the provision of real-time telemetry in order to have an individual contribution factor calculated, which may be more favourable than receiving a proportion of the Residual.

Where can I find more information?

See AEMO’s website for the Frequency Performance Payments project page.
See the AEMC’s website for the final determination and final rule.
For more information, please contact FPPconsultation@aemo.com.au.